From Blocks to Text Coding

Coding & STEM 4 Schools

An Introduction to Coding and Computational Thinking

Presented by Mr Daniel Hickmott

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Session Overview

- Yesterday, you:
  - Learned about Coding and Computational Thinking
  - Did some Unplugged activities and some Blocks Coding (with Scratch)
  - Learned about important some **Computational Concepts:** Sequences, Loops, Events and Parallelism
- Today you will learn about how to apply these concepts in Hybrid Coding Environments

Session Overview

- In this session, you will learn about:
  - the differences between Blocks, Hybrid and Text Coding environments
  - examples of different Blocks, Hybrid and Text environments
  - how Hybrid coding environments could help your students 'transition' from Blocks to Text Coding[1]

[1] http://www.terpconnect.umd.edu/~weintrop/papers/Weintrop&Wilensky_2019_C&E.pdf

Session Overview

- After a presentation about the different environments, you will complete an activity with PencilCode
- PencilCode is a Hybrid Coding Environment
- We will use Math + Coding to draw patterns and art
- You will apply these **Computational Concepts** you learned about yesterday: Sequences and Loops
- You will also learn about Operators (another **Computational Concept**)

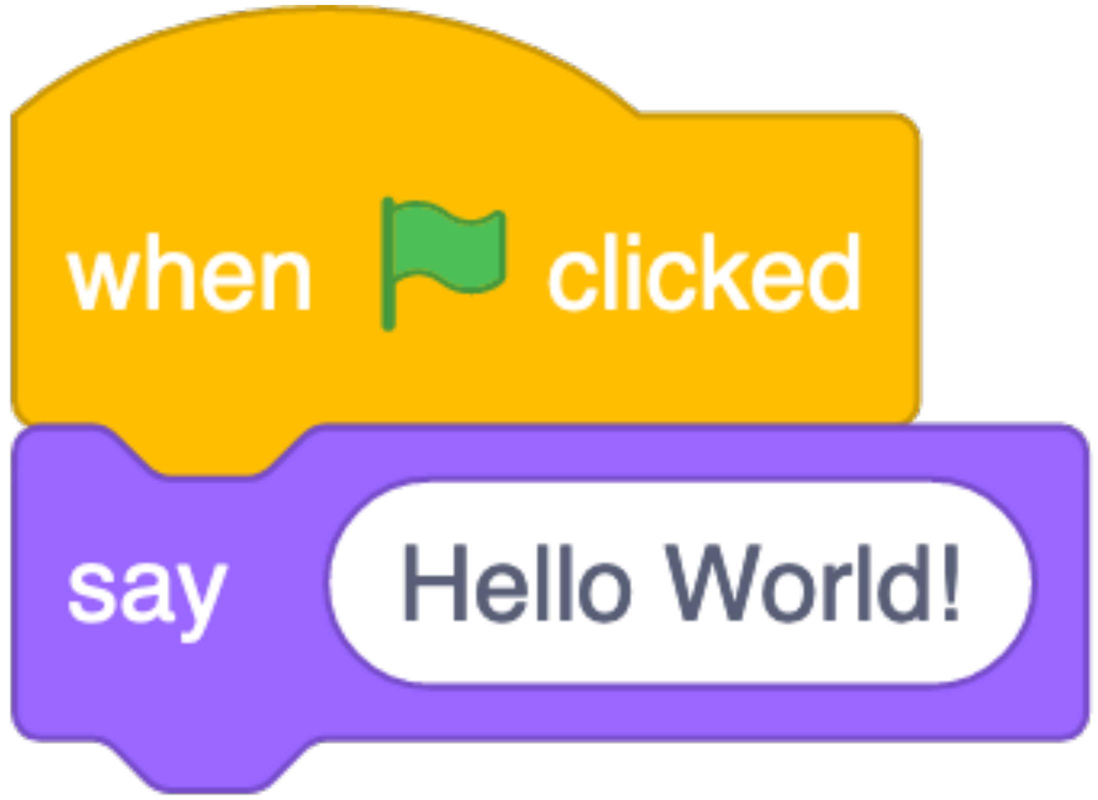
Syllabus Outcomes (in 2019 Syllabuses)

- New Technology Mandatory (7-8) Syllabus:
  - TE4-4DP: designs algorithms for digital solutions and implements them in a general-purpose programming language
- New Science & Technology K-6 Syllabus:
  - ST3-3DP-T: defines problems, and designs, modifies and follows algorithms to develop solutions

Visual vs General-Purpose Programming Languages

- Visual Programming languages (Blocks) usually:
  - utilise graphical elements (for example, puzzle pieces) to write programs
  - involve dragging and dropping blocks but there are some exceptions (for example, flowcharts)
- General-Purpose Programming languages (Text) are usually written using text only

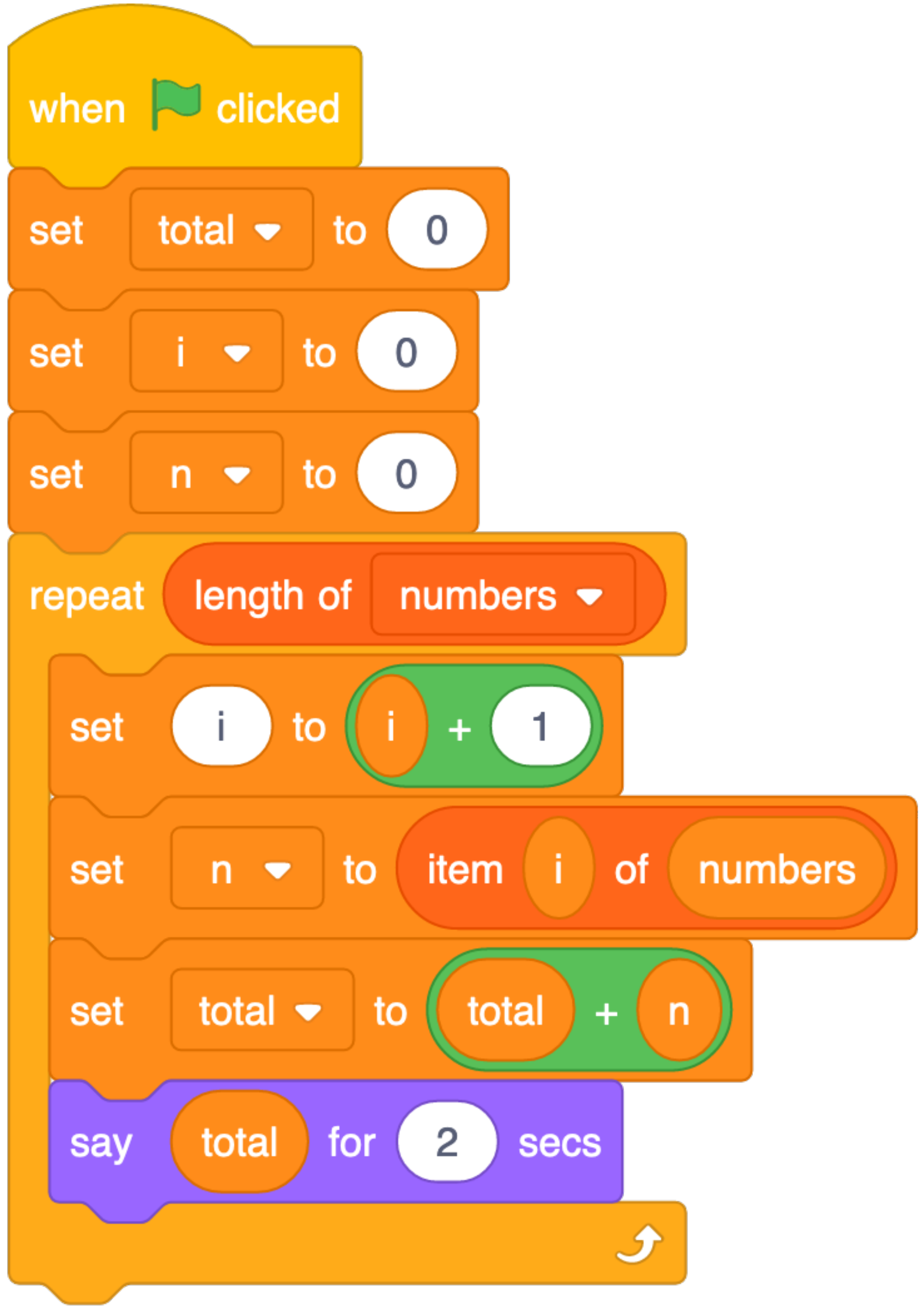
```c
#include<stdio.h>

main()
{
    printf("Hello World");
}
```



Blocks vs Text: Blocks

- Blocks Coding is popular in K-12 and also used for teaching Coding in some Universities
- Blocks languages are not usually used by professional Engineers and Scientists
- Very popular and a lot of current development and research work is being done to create and improve Blocks languages
- Scratch, Snap! (Build Your Own Blocks), LEGO Mindstorms... you may use others with your students

```
if __name__ == "__main__":
    total = 0
    i = -1
    numbers = [1,2,3,4
    for i in range(0, len(numbers)):
       i = i + 1
        n = numbers[i]
    total = total + n
    print(total)
```



Blocks vs Text: Text

- Unlike Blocks languages, you have to be more careful about typos and syntax when Coding in Text languages
- These languages are used by professional Engineers and Scientists in industry and research
- Used to develop the majority of software and apps
- Java, Python, C++, Swift… the list goes on

Blocks vs Text: Why Blocks?

- No syntax or spelling errors
- Lower cognitive load
- Students can focus on Computational Thinking
- Can see all the functions in one place
  - Scratch blocks
  - Python API documentation

Blocks vs Text: Why Blocks?

- Not just for kids!
- Scratch is used for 2 weeks of a Computer Science course at Harvard
- Unreal Blueprints can be used to code professional games
- NetLogo can be used for creating simulations for studying Science concepts at the High School and University level

Blocks vs Text: Why Text?

— Some cases where Text languages may be necessary

— Creating a website with a database (e.g. a Facebook-like website)

— Doing some serious Statistics / Data Science, e.g. R

— Coding some Physical Computing devices, like Arduinos

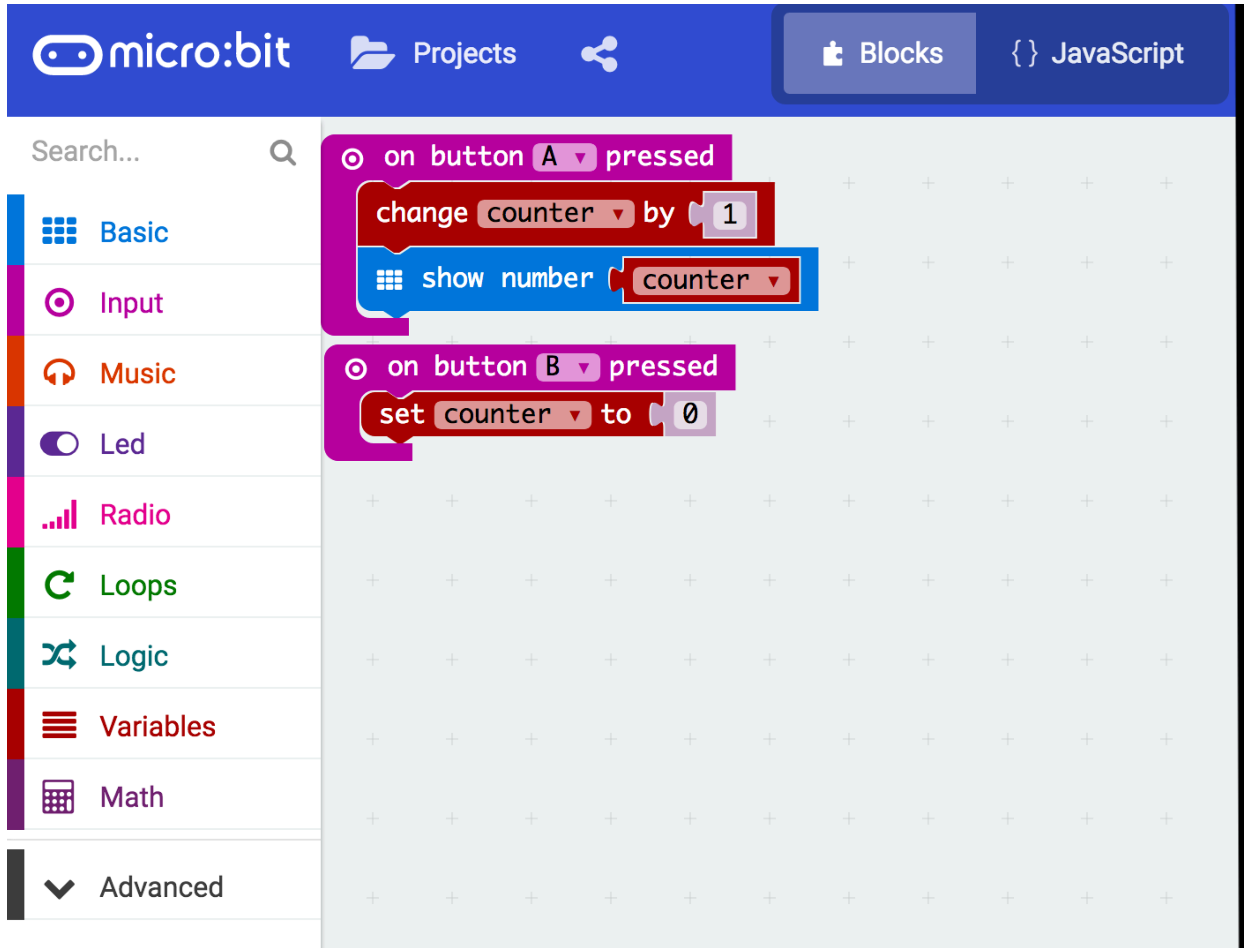
— Students may want to work in or study Coding after school

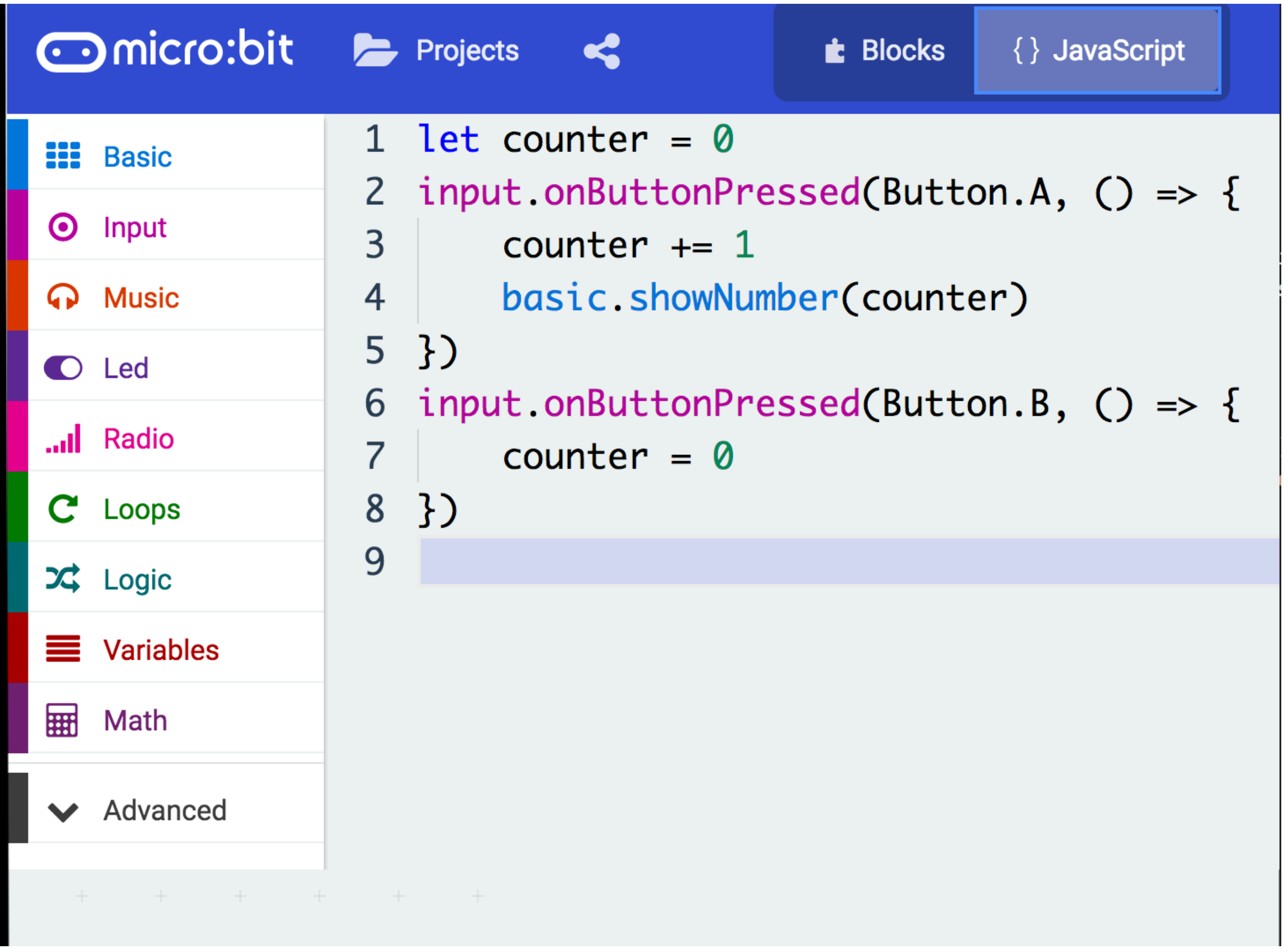
Moving from Blocks to Text

- You may:
  - have students that want to move to Text languages
  - want to teach a Text language for something a Block language cannot do
  - show students that Text languages can be approachable for beginners

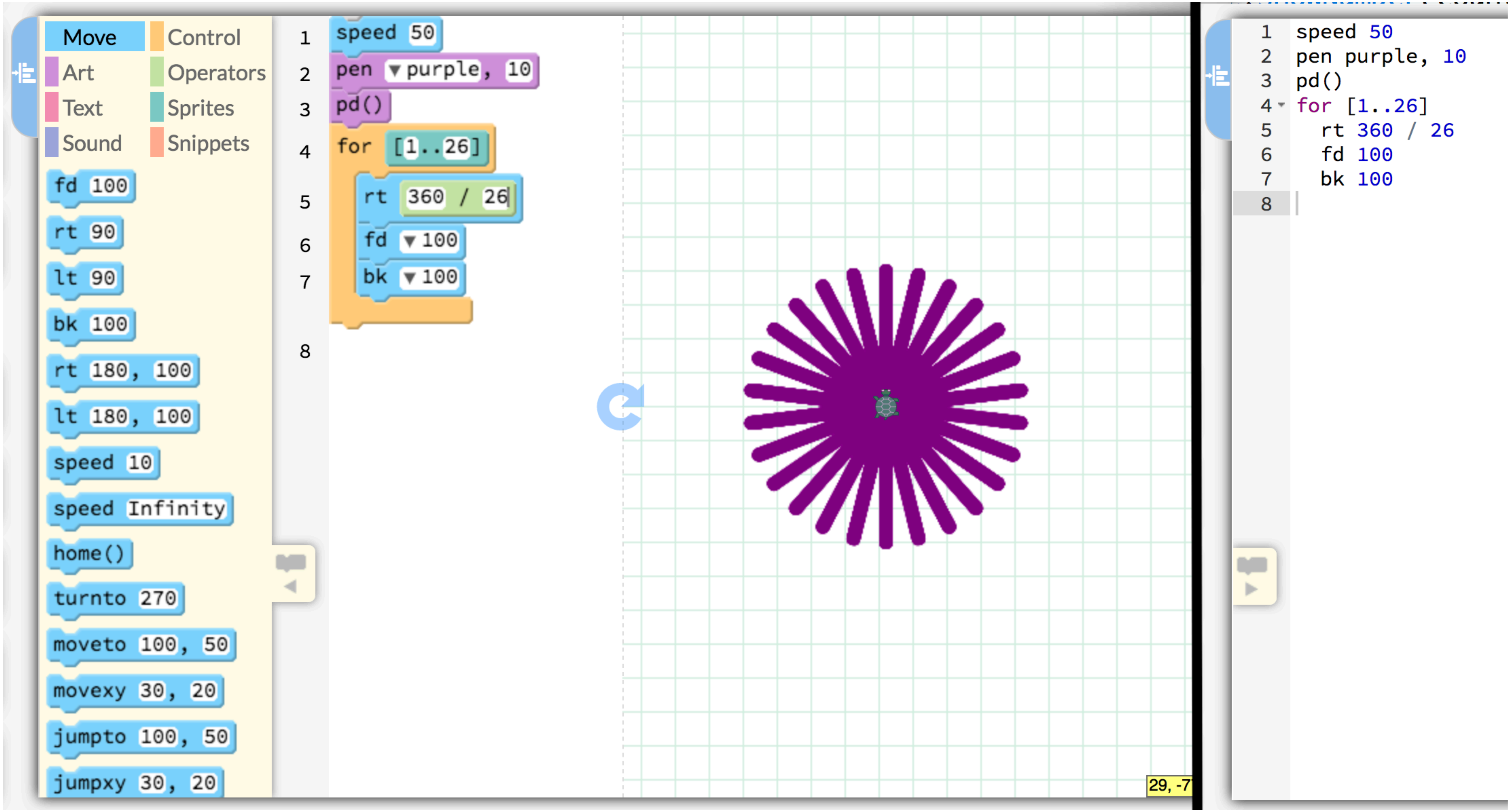
Hybrid Coding Environments

- Allow you to switch between Blocks and Text
- Could help as a "stepping stone" from Blocks to Text
- Some examples are:
  - PencilCode
  - Microsoft MakeCode (we will use this later)
  - Code.org's AppLab
  - Trinket





```
let counter = 0
input.onButtonPressed(Button.A, () => {
    counter += 1
    basic.showNumber(counter)
})
input.onButtonPressed(Button.B, () => {
    counter = 0
})
```



```
speed 50
pen purple, 10
pd()
for [1..26]
  rt 360 / 26
  fd 100
  bk 100
```

Using Hybrid Coding Environments

- Up until recently, there have mainly been Blocks and Text environments (not Hybrid) for teaching Coding
- Research on how K-12 students learn Text Coding (or how they move from Blocks to Text) is not extensive
- Some research on PencilCode students highlighted that students would switch back to Blocks when they could not remember the text commands
- Hybrid environments could be useful for differentiation

Introductory Text Languages

- Languages that make learning Text Coding simpler:
  - jsLogo (Logo)
  - Khan Academy Programming (JavaScript)
  - Sonic Pi (Ruby)
  - Processing (Java, Python or JavaScript)
- Could be useful for introducing Text languages in the context of creating multimedia: music, images and animations